Draft White Paper

SC&A REVIEW OF LAWRENCE BERKELEY NATIONAL LABORATORY SITE PROFILE MATRIX ISSUE #3

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SC&A reviewed the NIOSH response to Issue 3, in relation to the solubility of uranium and thorium compounds in the lung.

SC&A agrees with the NIOSH response that solubility Type S, as provided by the Human Respiratory Model described in ICRP 66 (ICRP 1994), adequately bounds the behavior of “high-fired” uranium. The same applies to thorium compounds.

In general, for insoluble material (Class Y or Type S), the ICRP 66 model describes a more tenacious retention in the thoracic region than does the ICRP 30 (ICRP 1979) model. For times remote from inhalation, the content of the lungs as predicted by the updated model is several times greater than that predicted by ICRP 30. Compared with the ICRP 30 lung model, the ICRP 66 model generally predicts lower absorption from the respiratory tract to blood for a given particle size, at least for particle sizes commonly encountered in the work place or environment. For 1-μm particles, predicted total absorption is about four times greater for Class Y than Type S (ORNL 2003).

As a consequence of the differences in the kinetics of the two models, the predicted excretion rates are not the same. In addition, the ICRP 30 systemic models have been updated. Current uranium and thorium models are described in ICRP Publication 78 (ICRP 1977).

Figures 1 and 2 below illustrate the differences in the predicted urine excretion rates of U-238, AMAD 1μm, using the ICRP 30 lung model and systemic models (labeled as class Y) and using the updated ICRP 66 lung model and ICRP 78 systemic model (labeled as Type S).

**Figure 1: Comparison of Urinary Excretion Rates of U-238: Class Y and Type S versus Time After Intake, AMAD = 1μm, at Early Times after Intake**

![Graph showing urinary excretion rates of U-238 for Class Y and Type S](image-url)
Figure 2: Comparison of Urinary Excretion Rates of U-238: Class Y and Type S versus Time After Intake, AMAD = 1 µm, at Early and Late Times after Intake

Many studies recently have been conducted to determine the solubility of various uranium compounds in the lung and their absorption rates to blood (Hodgson et al. 2000; Ansoborlo et al. 2002; and Stradling et al. 2002). None of those studies have shown lung retention that cannot be bounded by Type S. Studies conducted with uranium dioxides and U₃O₈ (Ansoborlo et al. 2002) have shown compatibility with Type S. The only exception to the general kinetics described by the assignment of Types F, M and S is for uranium aluminide (UAlₓ), as described by Leggett et al. (2005). Workers exposed to UAlₓ during the fabrication of reactor fuel plates, who were removed from exposure, had urinary excretion rates that increased for a few months, peaked, and then declined at a rate consistent with moderately soluble uranium.

The studies on thorium compounds are not as extensive as those on uranium compounds. Hodgson et al. 2000 and Hodgson et al. 2003 have concluded that the assignment of Type S was compatible with the kinetics of Th-232 dioxide administered to rats by intratracheal instillation.

In conclusion, SC&A agrees with NIOSH on their response to Matrix Issue #3.
REFERENCES


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